

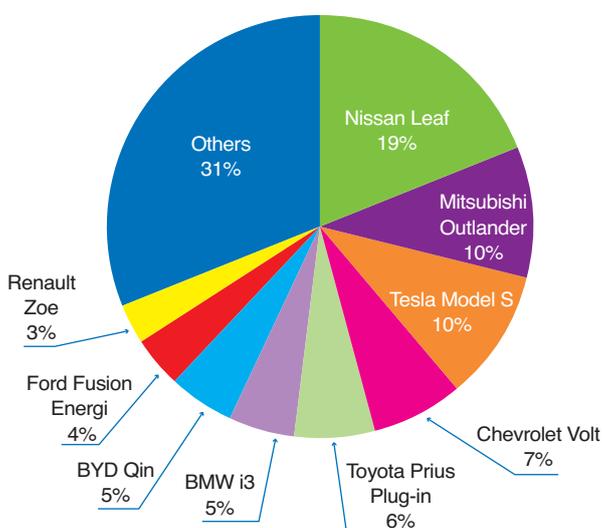
## Distribution of electrification in transportation: future prospects?

The automobile industry continues to transition toward a cleaner, more diversified range of vehicles. Hybrid vehicles have become a reality on our roads, and sales of electrical vehicles are on the rise. What are the realities of this growth? How can it be accelerated, and what may be the impacts of such a development?

### A developing market, rising sales

In 2014, approximately 320,000 plug-in vehicles (electric vehicles [EV] and plug-in hybrid electric vehicles [PHEV]) were sold worldwide. The Nissan Leaf prevailed with a 19% market share, far ahead of the Mitsubishi Outlander and the Tesla Model S (Fig. 1).

Fig. 1 – Market share in worldwide sales of electric and plug-in hybrid vehicles



Source: EVSALES.blogspot

Europe is the main market for electric vehicles with 45,000 registrations, ahead of the United States and China. However, Europe is not yet a homogeneous market (Fig. 2):

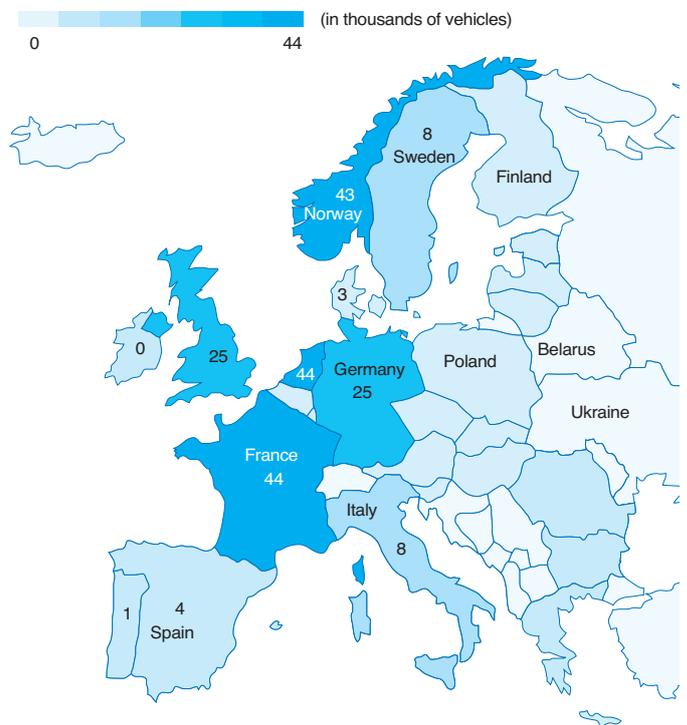
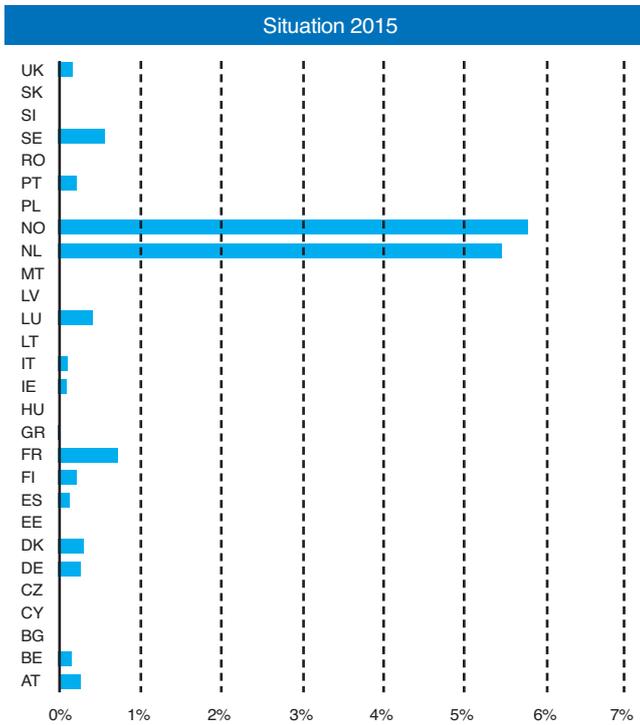
- the plug-in vehicle market is nonexistent in Eastern European countries;
- Germany, the United Kingdom and Spain have an EV market share of approximately 0.2-0.5%;
- France earned a spot on the podium with 1% of market share, but lags far behind the leaders, the Netherlands (5.5%) and Norway (6%).

Overall, 14,883 private and commercial electric vehicles have been registered in France since the beginning of 2015, up 48% over the same period in 2014 (Fig. 3). Private vehicles represent approximately three-quarters of this market, according to the *Association nationale pour le développement de la mobilité électrique* (National association for the development of electric transportation) (Avere).

Norway is a prime example, successfully developing a market very quickly by offering individuals a range of benefits to encourage the switch to electric vehicles. These benefits include tax breaks (free tax disc and VAT exemptions) and incentives to promote electric vehicle use, such as free parking and charging, toll exemptions and the right to use bus lanes. This policy has paid off, and has been renewed through 2017, when it will be phased out.

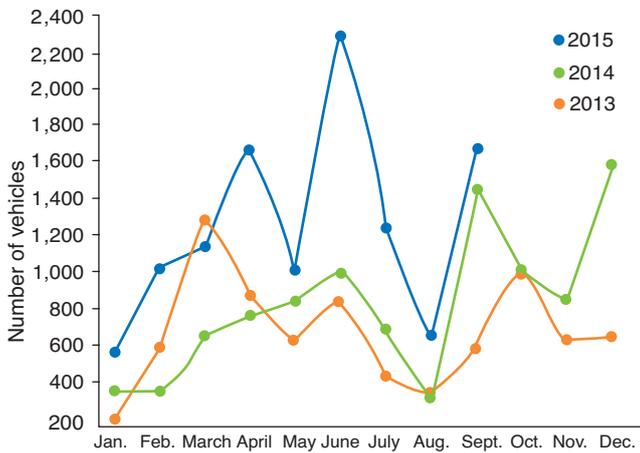
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Fig. 2 – Penetration rate for EV and plug-in hybrids in % of European sales (above) and vehicle fleets (below) in 2015.



Source: ICCT Pocketbook 2014, IEA Global EV Outlook 2015

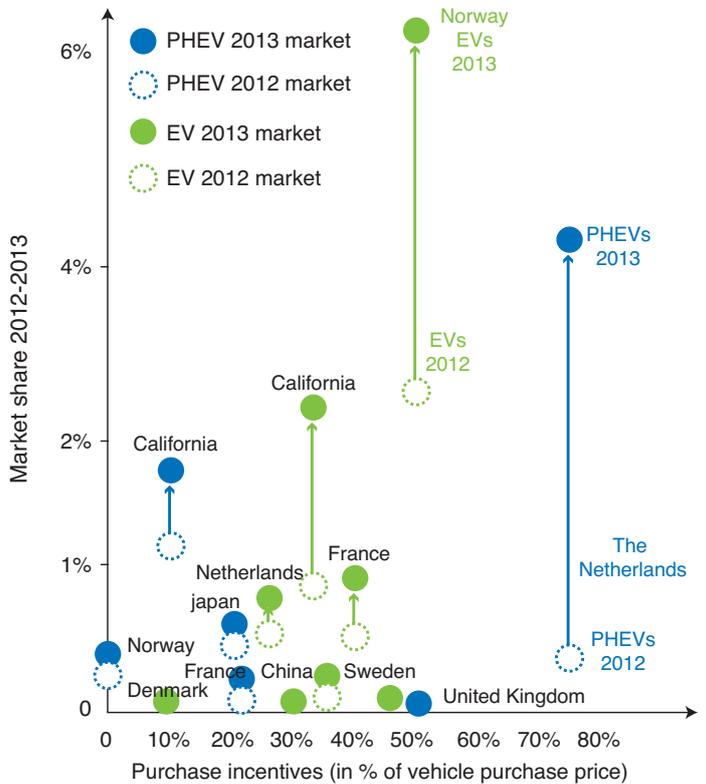
Fig. 3 – Increase over three years in monthly electric vehicles sales in France



Source: Avere

By way of illustration, Figure 4 shows the amount of purchase incentives for electric vehicles and plug-in hybrids in several countries (expressed in percentage of vehicle purchase price) and depicts the impact on market share between 2012 and 2013. Norway and the Netherlands clearly stand out, showing how public policy can play a powerful role in market creation.

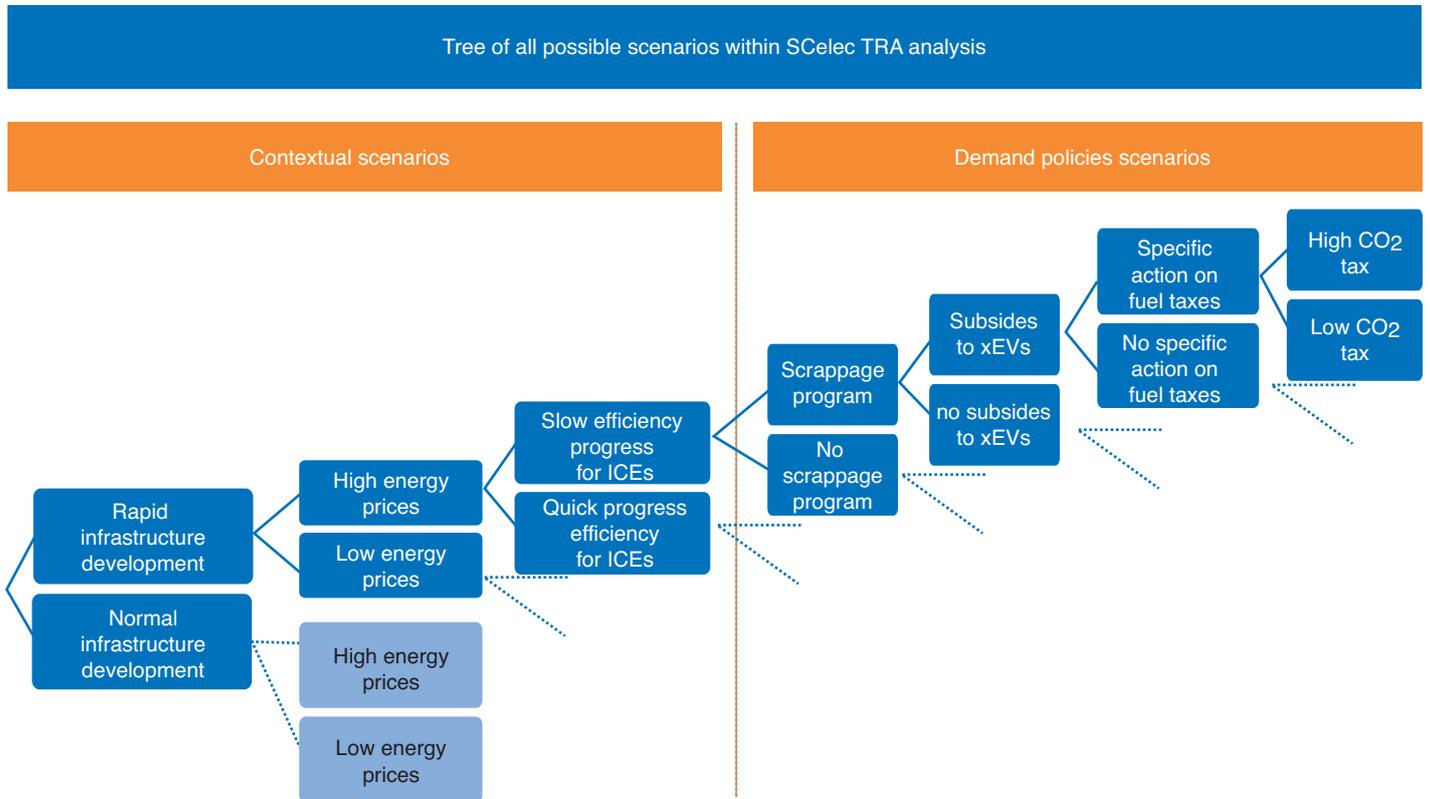
Fig. 4 – Purchase incentives (in % of vehicle purchase price) and market share in several countries around the world



Source: ICCT

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Fig. 5 – Tree of possible scenarios for both supply and demand



Source: SCelecTRA

## How to progress further and faster through targeted public policies?

SCelecTRA (Scenarios for the electrification of transport) is a collaborative project within the framework of the ERANET-Electromobility+ program, coordinated by IFPEN, which aims to:

- identify the conditions and public policies for the development of electric mobility (private electric vehicles and plug-in hybrids) in Europe by 2030;
- assess the impact of these scenarios on the environment and the energy system.

The main policies established in European countries to promote electric and hybrid vehicles and/or to renew vehicle fleets include CO<sub>2</sub>-based bonus payments at the time of purchase, fuel tax incentives, rebates on electricity taxes and purchase incentives.

An initial analysis quantified each country's response to these various indicators, and incorporated the results in an energy forecast model. In the end, three energy supply scenarios were coupled with four scenarios describing the potential political actions related to demand for transport (Fig. 5).

## Promote development of charging infrastructure and support the market with purchase incentives

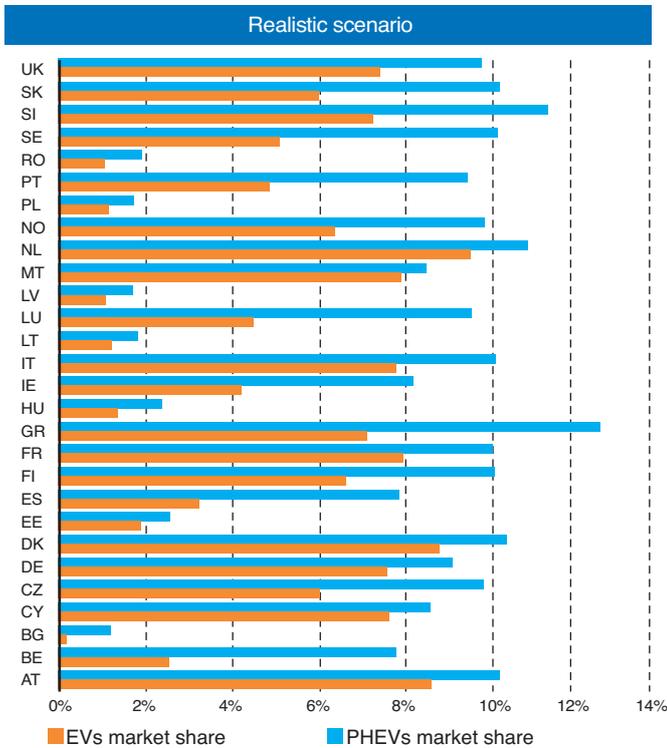
Development of the charging infrastructure appears to be the key factor in expanding the plug-in vehicle market. Even if this factor alone is not enough, it should be considered a key step toward advancing the plug-in vehicle market and giving it greater visibility, without which significant growth in electric mobility will not occur.

At the public policy level, SCelecTRA project simulations revealed that Member States should focus on programs that combine bonus payments at purchase to accelerate renewal of vehicle fleets purchase incentive programs that promote the entry of plug-in vehicles into the market. The French "super bonus" is a perfect example. It offers a €10,000 incentive to new purchasers who buy an electric vehicle while simultaneously scrapping a diesel vehicle over 10 years old. According to Avere, the super bonus has clearly boosted the French market.

In comparison, specific action on fuel taxes appears less effective and, in addition, the combined impact of both policies does not equal the sum of the individual policies' effects.

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Fig. 6 – Penetration rate of EVs and plug-in hybrids in European sales (above) and vehicle fleets (below) for the electromobility deployment scenario in Europe in 2030, according to the SCElecTRA project



Source: SCElecTRA

### Market share of 8% for EVs and 10 to 12% for plug-in hybrids could be achieved by 2030

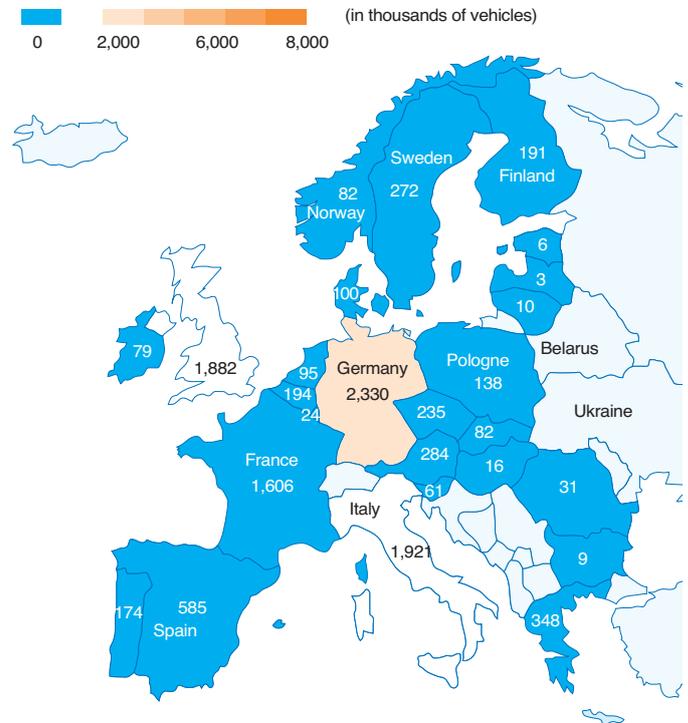
Analyses conducted under the SCElecTRA project concur that market shares of 6 to 8% for EVs and 10 to 12% for plug-in hybrids could certainly be achieved in Europe by 2030 (Fig. 6).

For electric vehicles, their market share could reach 8% in France, 7.5% in the United Kingdom and 7% in Germany.

In general, the increase of plug-in hybrid vehicles in each country would be slightly greater, without surpassing the 12% mark.

### Plug-in vehicles offer environmental benefits

The environmental benefits related to electrical vehicles as of 2030 were first evaluated. The life cycle analysis (LCA) shows that, for conventional vehicles, the vehicle usage phase is the main source of environmental impacts. Because electric vehicles create less impact



during this phase, the vehicle production phase takes on greater relative importance. Thus, the environmental impact of battery production becomes a major challenge for electric vehicles.

As a whole, electric vehicles represent the best environmental option over the lifecycle of a vehicle for certain impacts, such as demand for non-renewable primary energy sources and the global warming potential.

With regard to environmental impacts, the greatest reductions in tailpipe CO<sub>2</sub> emissions are achieved with the highest transport electrification rates, due to energy savings and lower local emissions of electrified vehicles.

### However, widespread electrification can lead to rebound effects and the transfer of emissions to other sectors

Due to the higher efficiency of electric vehicles, the greater demand for electricity associated with expansion of electric mobility represents only a small portion of total demand from transport, and of demand for electricity across all sectors combined. However, though marginal at the power sector level, the additional demand for electricity

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generated by electromobility would be covered by new installations, rather than by savings in the residential, commercial or industrial sectors.

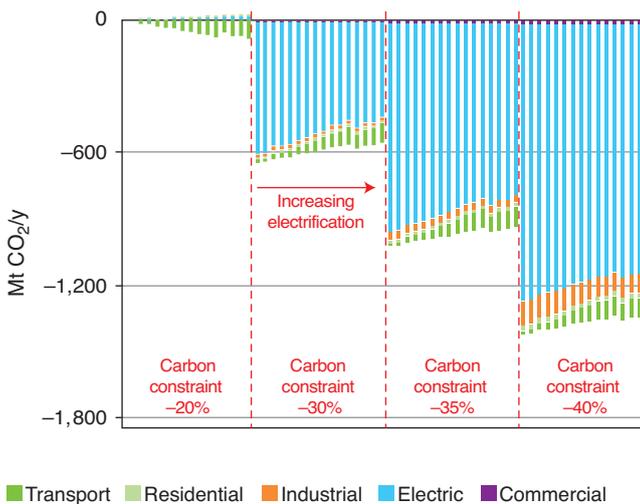
In addition, if a cap on greenhouse gas emissions is set across all sectors, any additional effort to reduce transport-related emissions will lead to higher emissions mainly in the power sector (Fig. 7), arising from new production units using coal, natural gas or nuclear power units, depending on the country. Thus, it is essential to balance efforts to reduce carbon emissions in the transportation and power sectors against the risk of eliminating their benefits. On the other hand, one benefit of introducing electric vehicles could not be accounted for in this study: they may offer significant potential for storing intermittent electricity and could help foster electricity mix diversification.

sustainable future. Simulations carried out as part of the SCElecTRA project were able to measure how market share of approximately 8 to 10% for electric vehicles in Europe could be achieved by 2030, by developing the charging infrastructure and supporting the market through purchase incentives.

These simulations affirmed the positive impact of electromobility on greenhouse gas emissions in the transportation sector, and showed the importance of finding the right level of electrification and the correct pace for its adoption, in line with the power sector, to achieve the optimal environmental impact across all sectors.

Simon Vinot – [simon.vinot@ifpen.fr](mailto:simon.vinot@ifpen.fr)  
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Fig. 7 – CO<sub>2</sub> emissions avoided (in MtCO<sub>2</sub>/year) compared with the baseline scenario, by sector



Source: SCElecTRA

The electric vehicle market is transforming in scale and expanding out of its niche market. It still requires support to achieve the momentum needed to ensure a



The SCElecTRA consortium was composed of five partners from three countries (France, Germany and Austria): Thinkstep, IFSTTAR, Kanlo, EIFER and IFPEN

<http://www.thinkstep.com/>

[www.ifsttar.fr](http://www.ifsttar.fr)

<http://www.kanors.com/Index.asp>

<https://www.eifer.kit.edu/>

[www.ifpenouvelles.com](http://www.ifpenouvelles.com)

More information on the project can be found at:  
[http://projet.ifpen.fr/Projet/jcms/xnt\\_79165/fr/scelectra](http://projet.ifpen.fr/Projet/jcms/xnt_79165/fr/scelectra)

All simulation results can be viewed and configured here:  
<http://vedaviz.com/Portal/Playground.aspx?p=Scelectra02Jun15&g=1a3c15>

and here :

<http://vedaviz.com/Presenter/Presenter.aspx?p=Scelectra02Jun15&g=3918c6>